# Comparison of $\bar{F}$, $\bar{E}$, $\Delta U_e$, $\Delta V$

| Equation: | Situation eqn. applies: |
|---|---|
| $F = \dfrac{k\lvert q_1\rvert\lvert q_2\rvert}{r_{12}^2}$ magnitude | two (or more) point charges |
| direction from attraction or repulsion of charges | if more than two q's, net force is found from by adding (1-D) or force triangle (2-D) |
| $E = \dfrac{k\lvert q\rvert}{r^2}$ | point charges |
| direction from charge +/- and configuration | |
| $U = \dfrac{kq_1q_2}{r_{12}}$ | point charges<br>use +/- of charge in eqn. |
| $V = \dfrac{kq}{r}$ | point charges<br>use +/- of charge in eqn. |
| $\Delta U_e = -q\bar{E}\cdot\bar{d}$ | parallel-plate capacitor |
| $\Delta V = -\bar{E}\cdot\bar{d}$ | parallel-plate capacitor |

## • Dielectrics:

- Material that is inserted bet. plates of a capacitor that increases the capacitance.

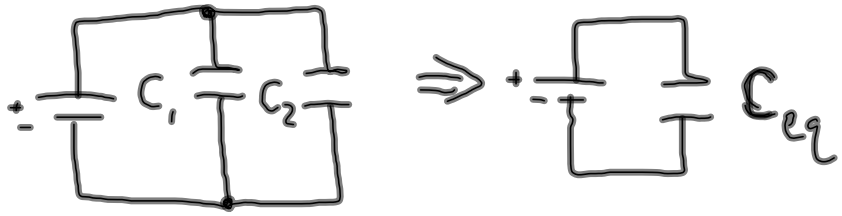
- Dielectric constant: $\kappa$ (Greek lowercase kappa)

- $C = \kappa C_0$
  - $C$ → capacitance
  - $\kappa$ → dielectric constant
  - $C_0$ → capacitance w/o dielectric

## • Energy stored in a capacitor:

$$U = \frac{Q^2}{2C} = \frac{1}{2}Q\Delta V = \frac{1}{2}C(\Delta V)^2$$

- Equivalent Capacitance:
  - find total C in a circuit
  - use series/parallel rules to break circuit down to one capacitor



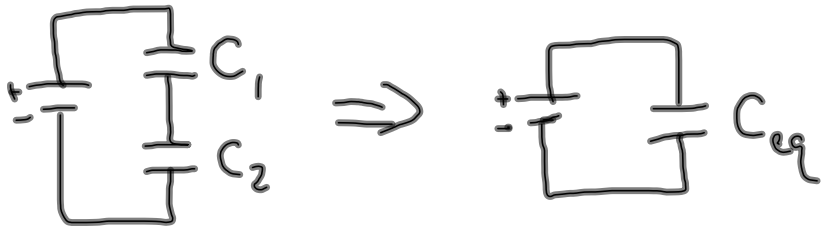

$C_1 = 10\,\mu F$

$C_2 = 20\,\mu F$

$C_{eq} = C_1 + C_2$

$= 10\,\mu F + 20\,\mu F$

$= 30\,\mu F$

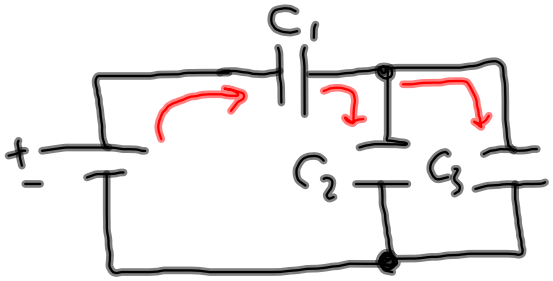



- Same values as above

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$

$C_{eq} = \left[\frac{1}{10\,\mu F} + \frac{1}{20\,\mu F}\right]^{-1}$

$= 6.67\,\mu F$

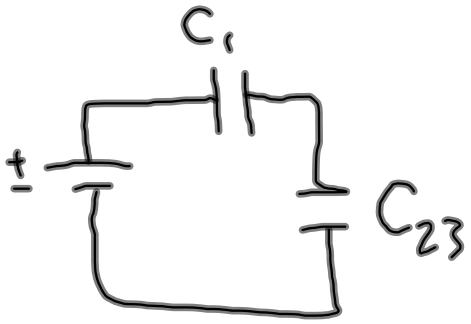



$C_1 = 10\,\mu F$

$C_2 = 20\,\mu F$

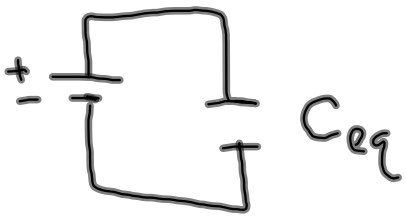
$C_3 = 20\,\mu F$

— work outside in



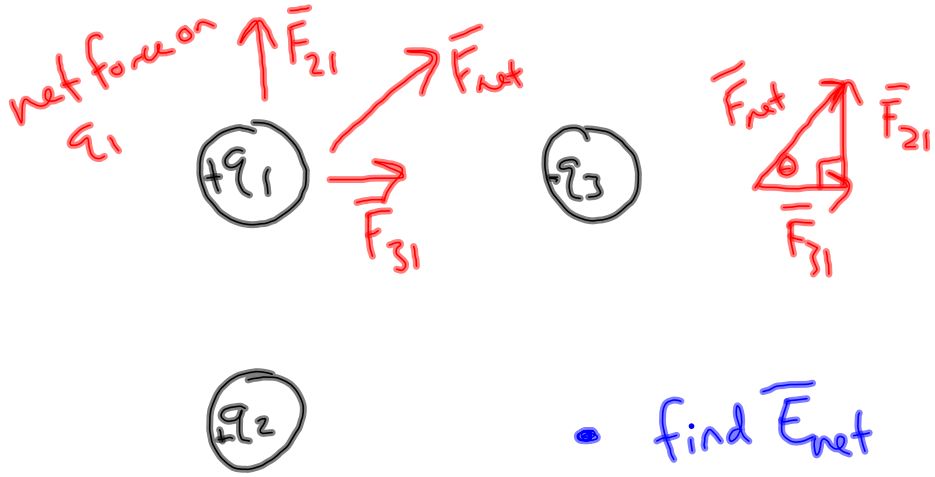

$C_{23} = C_2 + C_3$

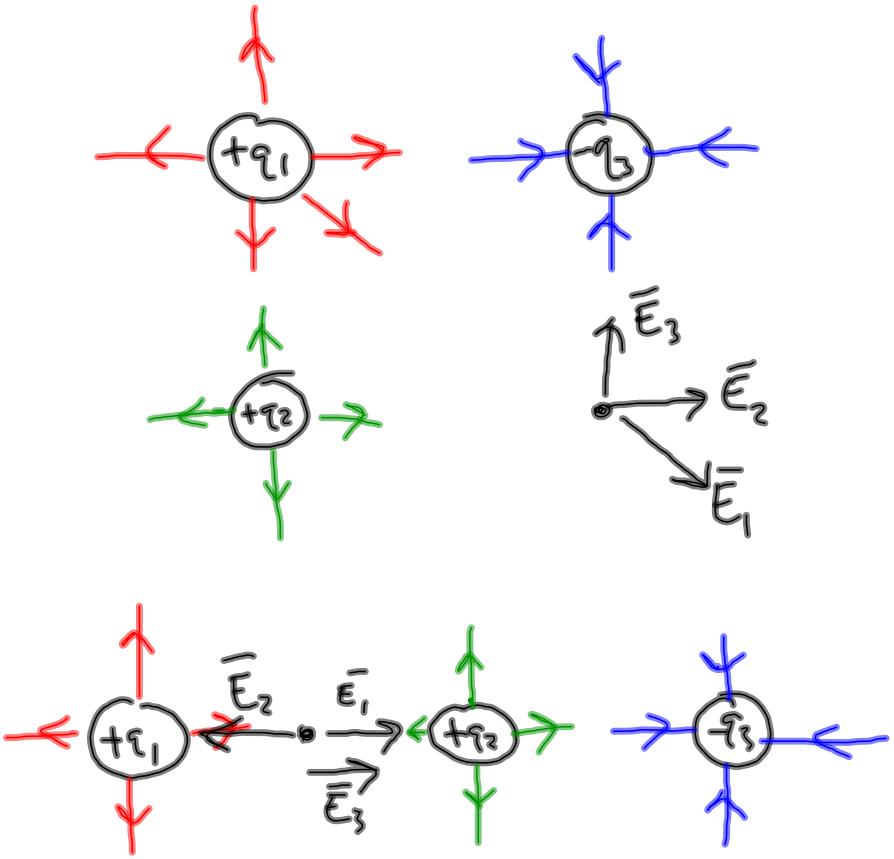
$= 40\,\mu F$




$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_{23}}$$

$C_{eq} = 8\,\mu F$


net force on $q_1$
$\bar{F}_{21}$
$\bar{F}_{net}$
$+q_1$
$\bar{F}_{31}$
$-q_3$
$\bar{F}_{net}$
$\bar{F}_{21}$
$\bar{F}_{31}$
$+q_2$
• find $\bar{E}_{net}$


$+q_1$
$-q_3$
$+q_2$
$\bar{E}_3$
$\bar{E}_2$
$\bar{E}_1$
$+q_1$
$\bar{E}_2$
$\bar{E}_1$
$\bar{E}_3$
$+q_2$
$-q_3$